PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2011**

College of Sciences

Section 4 **Quiz 12** **26 May 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: Solution **Student ID:** **Signature:**

A circuit is composed of a single loop with an alternating current source $V(t) = V_0 \cos(\omega t)$, an inductor L, a capacitor C, a resistor R, and an unkown circuit element. The resultant current is $I(t) = I_0 \cos(\omega t + \pi/4)$, and $R = \omega L = 1/4\,\omega C$.

(a) What is the unkown circuit element?

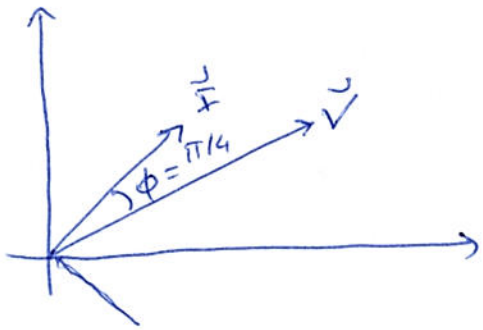
(b) Completely determine the characteristic of the unknown circuit element in terms of V_0, I_0, ω, t, X, L and C. (all of these will not be necessary).

$V(t) = V_0 \cos\omega t$, RLC and unknown element

$R = \omega L = \frac{1}{4\omega C}$ $\quad X_L = R$

$X_C = 4R$

Phasor diagram



$|X_L - X_C| = 3R$

since the angle is $45^\circ \Rightarrow |X_L - X_C + ?| = R$

we need to add **inductor with $X_L = 2R$**

$\therefore$ $L = \frac{2R}{\omega}$ $\quad I_0 = \frac{V_0}{\quad} = \frac{V_0}{\quad}$ thus $L = \frac{\sqrt{2}\,V_0}{\quad}$

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Section 3 **Quiz 12** **26 May 2011**

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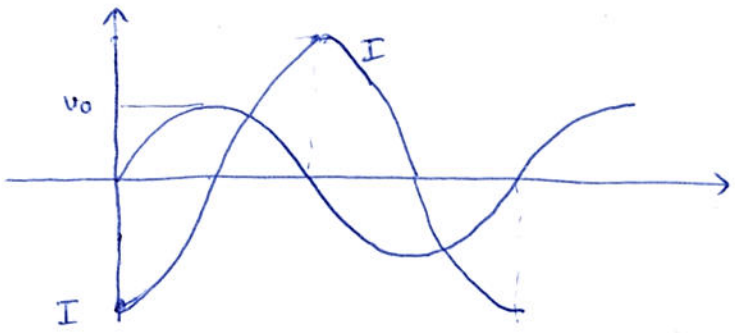
Quiz duration: 10 minutes

Name: Solution **Student ID:** **Signature:**

A circuit is composed of a single loop with an alternating current source $V(t) = V_0 \sin(\omega t)$, and an unkown element. If the resultant current is $I(t) = \frac{V_0}{R} \sin(\omega t - \pi/2)$, identify the unkown element and plot the current passing through this element together with the potential difference.



voltage leads current
therefore it is
inductor.

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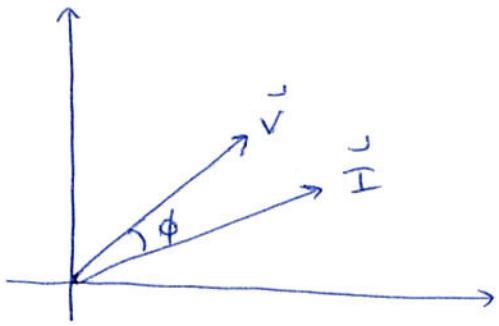
Section 2 **Quiz 12** **26 May 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: Solution **Student ID:** **Signature:**

A circuit is composed of a single loop with an alternating current source $V(t) = V_0 \cos(\omega t)$, an inductor L and a resistor R. Derive the power P(t) obtained from the alternating current source as a function of (V_0, ω, t, L, R).

Phasor diagram



If $V(t) = V_0 \cos \omega t$

$\Rightarrow$ $I(t) = I \cos(\omega t - \phi)$

$\Rightarrow$ $\phi = \arctan\left(\frac{\omega L}{R}\right)$

$$I = \frac{V_0}{Z} = \frac{V_0}{(R^2 + \omega^2 L^2)^{1/2}}$$

$$\therefore I(t) = \frac{V_0}{\sqrt{R^2 + \omega^2 L^2}} \cdot \cos\left(\omega t - \arctan\left(\frac{\omega L}{R}\right)\right)$$

$$P(t) = I(t)\, V(t) = \frac{V_0}{\sqrt{R^2 + \omega^2 L^2}} \cos\left[\omega t - \arctan\left(\frac{\omega L}{R}\right)\right] \cdot \left[V_0 \cdot \cos(\omega t)\right]$$

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Section 1 **Quiz 12** **26 May 2011**

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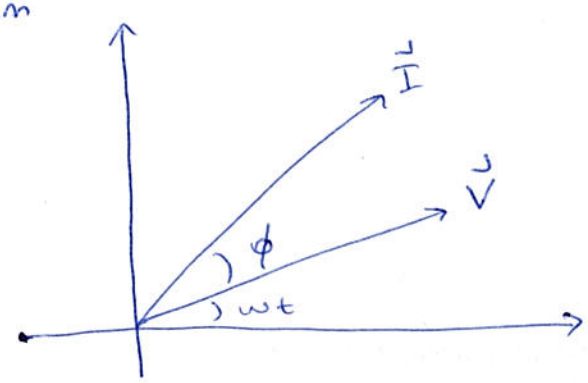
Quiz duration: 10 minutes

Name: Solution **Student ID:** **Signature:**

A circuit is composed of a single loop with an alternating current source $V(t) = V_0 \cos(\omega t)$, a capacitor C and a resistor R. Derive the current I(t) as a function of (V_0, ω, t, C, R).

Phasor diagram



If $V(t) = V_0 \cos \omega t$

$\Rightarrow$ $I(t) = I \cos(\omega t + \phi)$

$\Rightarrow$ $\phi = \arctan\left(\frac{X_C}{R}\right) = \arctan\left(\frac{1}{\omega C R}\right)$

$\Rightarrow$ $I = \frac{V_0}{Z}$, $Z = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$

$\therefore$ $I(t) = \frac{V_0}{Z} \cos(\omega t + \phi) = \frac{V_0}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}} \cos\left[\omega t + \arctan\left(\frac{1}{\omega C R}\right)\right]$

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Section 5 **Quiz 12** **26 May 2011**

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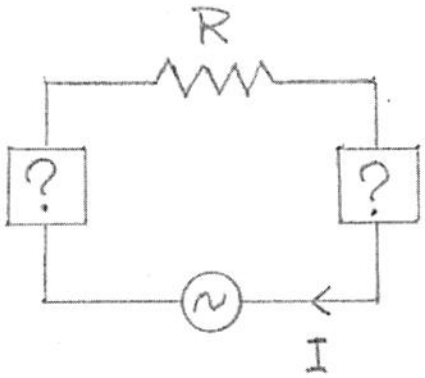
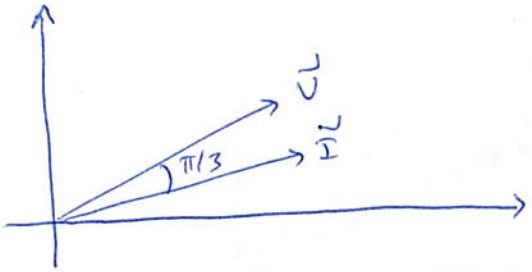
Quiz duration: 10 minutes

Name: Solution **Student ID:** **Signature:**

A circuit is composed of a single loop with an alternating current source $V(t) = V_0 \cos(\omega t)$, two unknown circuit elements and a resistor R.
The current is $I(t) = I_0 \cos(\omega t - \pi/3)$.



(a) What are the circuit elements in the boxes with the question marks?
(b) Determine I_0 in terms of (V_0, R, ω, t) (all of these may not be necessary).



$X_L - X_C > 0$

(a) It can be 2 inductor or LC with $X_L > X_C$

(b) I choose L and L as unknown elements $\Rightarrow$ their total reactance is X_L

$Z \cdot \sin\frac{\pi}{3} = X_L$

$Z \cdot \cos\frac{\pi}{3} = R$

$I_0 = \frac{V_0}{Z} = \frac{V_0}{\sqrt{R^2 + \omega^2 L^2}}$ and $L = R \tan\frac{\pi}{3}$